

What is claimed is:

1. An image processing system comprising:

sensing means for sensing a projection area on which an image is projected and
5 outputting sensing information;

histogram generation means for generating histogram information that expresses
histograms of the numbers of pixels of the sensed image in each of the vertical and
horizontal directions, based on the sensing information;

direction determination means for generating direction information, based on an
10 angle between a normal direction orthogonal to the projection area from a sensing
position and a projected image direction toward a central portion of the projected image
from the sensing position; and

keystone distortion correction means for correcting keystone distortion of the
projected image; based on the histogram information and the direction information.

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2. The image processing system as defined in claim 1, comprising:

a portable device having the sensing means, the histogram generation means,
and the direction determination means; and

an image display device having the keystone distortion correction means and
20 projection means for projecting an image,

wherein the keystone distortion correction means includes:

vertical keystone distortion correction means having inclination detection means
for detecting the inclination of the image display device, for correcting keystone
distortion in the vertical direction; and

25 horizontal keystone distortion correction means for correcting keystone
distortion in the horizontal direction, based on the histogram information and the
direction information.

3. An image processing system comprising:

light projection means for projecting light of a distortion-free and predetermined shape into a projection area;

5 sensing means for outputting sensing information obtained by sensing the projection area into which the light of the predetermined shape is projected, from a projection position of a projection section for projecting an image;

area extraction means for extracting coordinates of the light of the predetermined shape in a sensed area, based on the sensing information; and

10 keystone distortion correction means for converting the coordinates of the light of the predetermined shape in the sensed area into coordinates for projection in a spatial light modulator of the projection section, and correcting keystone distortion by mapping coordinates of an input image into the projection coordinates.

15 4. The image processing system as defined in claim 3, wherein:

the predetermined shape is rectangular or square;

the area extraction means extracts coordinates of four corners of the light of the predetermined shape; and

the keystone distortion correction means converts the coordinates of the four
20 corners of the light of the predetermined shape in the sensed area into coordinates for projection in a spatial light modulator of the projection section, and corrects keystone distortion by mapping the coordinates of an input image into an area formed by the projection coordinates of the four corners.

25 5. The image processing system as defined in claim 3, comprising:

a portable device having the light projection means; and

an image display device having the sensing means, the keystone distortion

correction means, and the projection section.

6. A projector comprising:

projection means for projecting an image;

5 receiving means for receiving histogram information that expresses histograms of the numbers of pixels of the sensed image in each of the vertical and horizontal directions, based on sensing information obtained by sensing a projection area on which the projected image is projected, and direction information based on an angle between a normal direction orthogonal to a projection area from a sensing position and a projected
10 image direction toward a central portion of the projected image from the sensing position; and

keystone distortion correction means for correcting keystone distortion of the projected image, based on the histogram information and the direction information.

15 7. The projector as defined in claim 6,

wherein the keystone distortion correction means includes:

vertical keystone distortion correction means having inclination detection means for detecting the inclination of the projection means, for correcting keystone distortion in the vertical direction; and

20 horizontal keystone distortion correction means for correcting keystone distortion in the horizontal direction, based on the histogram information and the direction information.

8. A projector comprising:

25 sensing means for outputting sensing information obtained by sensing a projection area into which light of a distortion-free and predetermined shape is projected, from a projection position of a projection section for projecting an image;

area extraction means for extracting coordinates of the light of the predetermined shape in a sensed area, based on the sensing information;

keystone distortion correction means for converting the coordinates of the light of the predetermined shape in the sensed area into coordinates for projection in a spatial light modulator of the projection section, and correcting keystone distortion by mapping

coordinates of an input image into the projection coordinates; and
the projection section.

9. The projector as defined in claim 8, wherein:

the predetermined shape is rectangular or square;

the area extraction means extracts coordinates of four corners of the light of the predetermined shape; and

the keystone distortion correction means converts the coordinates of the four corners of the light of the predetermined shape in the sensed area into coordinates for projection in a spatial light modulator of the projection section, and corrects keystone distortion by mapping the coordinates of an input image into an area formed by the projection coordinates of the four corners.

10. A portable device comprising:

sensing means for sensing a projection area on which an image is projected;

histogram generation means for generating histogram information that expresses histograms of the numbers of pixels of the sensed image in each of the vertical and horizontal directions, based on sensing information obtained by the sensing means;

direction determination means for determining direction information based on an angle between a normal direction orthogonal to the projection area from a sensing position and a projected image direction toward a central portion of the projected image from the sensing position; and

transmitter means for correcting keystone distortion of the projected image, based on the histogram information and the direction information, and transmitting the histogram information and the direction information to an image display device that projects the projected image.

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11. An image processing system comprising:

a sensing section which senses a projection area on which an image is projected and outputting sensing information;

10 a histogram generation section which generates histogram information that expresses histograms of the numbers of pixels of the sensed image in each of the vertical and horizontal directions, based on the sensing information;

15 a direction determination section which generates direction information, based on an angle between a normal direction orthogonal to the projection area from a sensing position and a projected image direction toward a central portion of the projected image from the sensing position; and

a keystone distortion correction section which corrects keystone distortion of the projected image, based on the histogram information and the direction information.

12. An image processing system comprising:

20 a light projection section which projects light of a distortion-free and predetermined shape into a projection area;

a sensing section which outputs sensing information obtained by sensing the projection area into which the light of the predetermined shape is projected, from a projection position of a projection section for projecting an image;

25 an area extraction section which extracts coordinates of the light of the predetermined shape in a sensed area, based on the sensing information; and

a keystone distortion correction section which converts the coordinates of the

light of the predetermined shape in the sensed area into coordinates for projection in a spatial light modulator of the projection section, and correcting keystone distortion by mapping coordinates of an input image into the projection coordinates.

5 13. A projector comprising:

a projection section which projects an image;

a receiver section which receives histogram information that expresses histograms of the numbers of pixels of the sensed image in each of the vertical and horizontal directions, based on sensing information obtained by sensing a projection
10 area on which the projected image is projected, and direction information based on an angle between a normal direction orthogonal to a projection area from a sensing position and a projected image direction toward a central portion of the projected image from the sensing position; and

a keystone distortion correction section which corrects keystone distortion of the
15 projected image, based on the histogram information and the direction information.

14. A projector comprising:

a sensing section which outputs sensing information obtained by sensing a projection area into which light of a distortion-free and predetermined shape is projected,
20 from a projection position of a projection section for projecting an image;

an area extraction section which extracts coordinates of the light of the predetermined shape in a sensed area, based on the sensing information;

a keystone distortion correction section which converts the coordinates of the light of the predetermined shape in the sensed area into coordinates for projection in a
25 spatial light modulator of the projection section, and correcting keystone distortion by mapping coordinates of an input image into the projection coordinates; and

the projection section.

15. A portable device comprising:

a sensing section which senses a projection area on which an image is projected;

a histogram generation section which generates histogram information that
5 expresses histograms of the numbers of pixels of the sensed image in each of the
vertical and horizontal directions, based on sensing information obtained by the sensing
section;

a direction determination section which determines direction information based
on an angle between a normal direction orthogonal to the projection area from a sensing
10 position and a projected image direction toward a central portion of the projected image
from the sensing position; and

a transmitter section which corrects keystone distortion of the projected image,
based on the histogram information and the direction information, and transmitting the
histogram information and the direction information to an image display device that
15 projects the projected image.

16. An image processing method comprising:

sensing a projection area on which an image is projected and outputting sensing
information;

20 generating histogram information that expresses histograms of the numbers of
pixels of the sensed image in each of the vertical and horizontal directions, based on the
sensing information;

detecting a normal direction orthogonal to the projection area from a sensing
position;

25 detecting a projected image direction toward a central portion of the projected
image from the sensing position;

generating direction information, based on an angle between the normal

direction and the projected image direction; and

correcting keystone distortion of the projected image, based on the histogram information and the direction information.

5 17. The image processing method as defined in claim 16, comprising:

detecting inclination of an image display device;

correcting keystone distortion in the vertical direction, based on the detected inclination; and

10 correcting keystone distortion in the horizontal direction, based on the histogram information and the direction information.

18. An image processing method comprising:

projecting light of a distortion-free and predetermined shape into a projection area;

15 outputting sensing information obtained by sensing the projection area into which the light of the predetermined shape is projected, from a projection position of a projection section for projecting an image;

extracting coordinates of the light of the predetermined shape in a sensed area, based on the sensing information; and

20 converting the coordinates of the light of the predetermined shape in the sensed area into coordinates for projection in a spatial light modulator of the projection section, and correcting keystone distortion by mapping coordinates of an input image into the in the sensed area projection coordinates.

25 19. The image processing method as defined in claim 18,

wherein the predetermined shape is rectangular or square; and the method including:

extracting coordinates of four corners of the light of the predetermined shape when coordinates of the light of the predetermined shape in the sensed area are extracted; and

5 converting the coordinates of the four corners of the light of the predetermined shape in the sensed area into coordinates for projection in the spatial light modulator of the projection section, and correcting keystone distortion by mapping coordinates of an input image into an area formed by the projection coordinates of the four corners, when the keystone distortion is corrected.

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